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INTERLUDE: A SERIES CONTAINING A HEMEROLOGY WITH LENGTHS OF DAYLIGHT

Franziska Naether[1] and Micah Ross[2]

Background

In the fall of 2004, the late Professor Pingree requested an account of "any texts containing numbers" among the archives of Medînet Mâdi. OMM 796 was received in response. At this point, however, the significance of its numbers was not understood. Shortly thereafter, Angiolo Menchetti recognized OMM 844 as a related piece and identified the last section as *ḥb*, "the epagomenal days". With this identification, the purpose of the series of ostraca became clearer. At Pisa in the spring of 2005, Micah Ross identified OMM 170 as the first element of the series. From this point, it became evident that the series consisted of four ostraca. In the spring of 2007, Franziska Naether and Micah Ross unsuccessfully attempted to identify the missing element in the Laboratorio di Demotico at the Università di Pisa. In the search for an understanding of this series, Friedhelm Hoffman graciously offered several useful suggestions about difficult readings.

To repeat, OMM 170 contains the first section. OMM 796 continues the series. OMM 844 concludes the composition. The second element of the series has not yet been identified. Although this element may still be located among the unpublished ostraca of Medînet Mâdi in the Egyptian Museum in Cairo, the second piece may also be one of the 84 pieces damaged by salt since their discovery by Achille Vogliano in 1937. Or, since there is no evidence that such a piece was ever retrieved by Vogliano, there remains the possibility that the loss of this element occurred in antiquity and that it was never found.

Through the correlation of the months and the lengths of daylight, the ostraca can be assigned a date between A.D. 112 and 232, with a preference for the latter half of this span. In light of other dates from Medînet Mâdi, sometime between A.D. 170 and 200 is most likely.[3]

These ostraca contain no title, explanation or commentary. Each ostracon contains one,

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3 For an updated bibliography on edited texts from Medînet Mâdi, see Menchetti and Pintaudi, (2007, 227, n. 2). In the Trismegistos database available on line at http://www.trismegistos.org, the ostraca treated in this article have been assigned the number 111880.

two, or three lines separated by a horizontal register. Each register, in turn, contains three elements. The first element of each register contains the numbers from 1 to 12 serially, save for the last register which begins with *ḥb*, “epagomenal days”. This element indicates the month of the year. The second element is a set of numbers between 1 and 30. These numbers specify days of each month. The final element is a fraction. Though the text includes no explanation, this fraction may be interpreted as related to the seasonal hours of daylight.

Plan of the Work

In order to establish the text, transcriptions of the three ostraca are presented. A transliteration follows each transcription, and a continuous translation of all three ostraca is presented after the text has been determined. After the translation, difficulties in reading and interpretation are treated in a commentary. At first glance, the text contains little more than a list of numbers. These numbers can be divided into a portion which resembles a calendar and a portion which contains fractions. In order to elucidate the meaning of the months and days in the text, the genre of hemerologies and their social context have been presented. Then, in order to provide a context for the fractions which conclude each month, seasonal hours are reviewed, and techniques for calculating the change in length of daylight are considered.

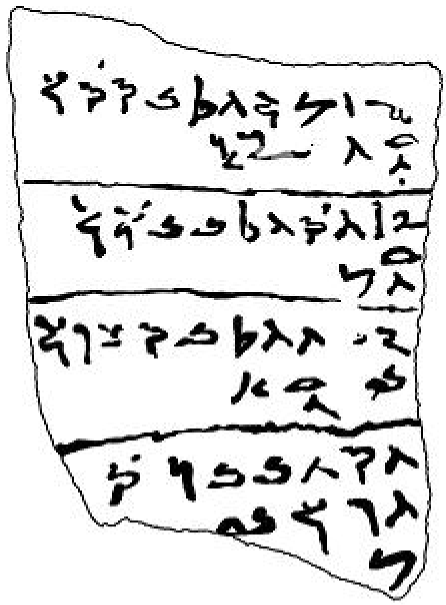
Transcription

OMM 170 (see Plate 1)
Height: 7.8 cm
Width: 6.2 cm

Transliteration
OMM 170

1. *wʿ: wʿ, 2, 3, 4,*
2. *10, 13, 14, 15,*
3. 20, *ʿrḳy. H̱r 1/1*[*3*].
4. *2: 1, 6, 8,* [*10*+x]*, 18 šʿ 24,*
5. *ʿrḳy. H̱r* 1/16.
6. *. . . 3: Hrw 3, 20, ʿrḳy. Šʿy.*
7. *H̱r 1/13 nꜣy.*

Transcription



OMM 796 (see Plate 1)
Height: 7.9 cm
Width: 6.5 cm

Transliteration
OMM 796

1. *7: 1, 4 šʿ 13, 21 šʿ ʿrḳy.*
2. *1/10. Šʿy 2.t.*
3. *8: 1, 10 šʿ 13, 20, 21, ʿrḳy.*
4. *1/14.*
5. *9:* [*3*]*, 10, 13, 21 šʿ* [*2*]*5, ʿrḳy.*
6. *H̱r 1/16.*
7. *10: 1, 10, 20, 22 šʿ*
8. *15, ʿrḳy. H̱r*
9. [*1*]*/*[*1*]*4.*

Transcription

OMM 844 (see Plate 1)
Height: 10.5 cm
Width: 8.7 cm

Transliteration
OMM 844

1. *11: 1, 10, 23 šꜣ sw 25,* [*ʿrḳy*].
2. *H̱r 1/1*[*3*].
3. *12: 1, 10, 13, 20, ʿrḳy. 1/12 nꜣy.*
4. *Ḥb: 3, 4, 5. H̱r 1/12 nꜣy.*

Translation

OMM 170

1. (Month) 1: (Day) 1, 2, 3, 4,
2. 10, 13, 14, 15
3. 20, last day. By 1/1[3]

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4. (Month) 2: (Day) 1, 6, 8, [10+x], 18 until 24,
5 last day. By 1/16.

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6 ... (Month) 3: Day 3, 20, last day. Festival.
7 They are [multiplied?] by 1/13.

OMM 796

1 (Month) 7: (Day) 1, 4 until 13, 21 until last day.
2 1/10. 2 Festivals.

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3 (Month) 8: (Day) 1, 10 until 13, 20, 21, last day.
4 1/14.

---

5 (Month) 9: (Day) [3], 10, 13, 21 until [2]5, last day.
6 By 1/16.

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7 (Month) 10: (Day) 1, 10, 20, 22 until
8 15 (=25), last day. By
9 [1/1]4.

OMM 844

1 (Month) 11: (Day) 1, 10, 23 until day 25, last day.
2 By 1/1[3].

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3 (Month) 12: (Day) 1, 10, 13, 20, last day. They are 1/12.
4 Epagomenal Days: 3, 4, 5. They are [multiplied?] by 1/12.

Commentary

According to some philosophies, transliterations ought to avoid capitalizations, punctuations and other aids to reading, lest the interpretation be corrupted by editorializing.[4] For others, such conventions serve as an aid to reading. Because transcriptions have been presented and because digital photographs of the ostraca are easily available, the latter approach has been adopted for this series.

OMM 170

1: In the transliteration, *wꜤ* and 1 have been distinguished, although they both have the same meaning. The word *wꜤ* appears for 1 at the beginning of numbers in P. Carlsberg 31, but in the present series, the scribe follows no consistent practice. In composite numbers like 11 and 21, the number is always written with the numeral for "1". In OMM 796, lines

[4] For a fuller treatment of transliteration systems, see Depauw, (1997, 70-71).

1 and 3, and in OMM 844, lines 1 and 3, the scribe used a simple vertical stroke to write the number one. The scribe used *w*ʕ only twice in OMM 170, line 1 and in line 4.

A portion of the top of the “4” has been rubbed away.

3: Perhaps 1/13 can be restored as parallel to OMM 170, line 7, and in succession to OMM 844, line 4. A general note about the grammatical context of the fractions is necessary. In five cases, the fractions serve as the objects of prepositional phrases. In OMM 796, lines 2 and 4, the fractions appear with no prepositions. In OMM 844, line 3, the fraction appears to be one half of a bi-partite sentence: “They are 1/12”. The phrasing of OMM 170, line 7, and OMM 844, line 4, challenges grammatical sense. Presumably, the meaning of these constructions is the same with the exception of the quantity of the fraction. In OMM 170, line 7, and OMM 844, line 4, the prepositional phrase is followed by a troublesome sign which may be the copula. Though the reading cannot be forced into any sentence type known from descriptive grammars, the sign cannot be read as “one half,” since numeric expressions obey their own rules and larger fractions conventionally precede smaller fractions. Reading the sign as “one half” further implies that these three months contained two fractions, and the instances of “one half” remain unexplained. Furthermore, the ostraca conform more to the genre of list than that of literary composition, and lists adhere to different rhetorical structures than literary compositions.[5] Hence it makes sense to look not just for grammatical conformity but also for parallel rhetorical structures common to lists.

4: The section interpreted as “6, 8” is badly damaged and is not certain. The second number may be read as 8 or 9. Alternately, the two numbers could be linked as “7,” . The number in the space after these traces has been entirely destroyed, but it is probably less than 18 and greater than 9.

5: Presumably, the schema of seasonal hours ought to preserve symmetry with the entries six months later. So, 1/16 is unexpected here, but perhaps 1/14 ought to be read. For further details, see the discussion of the computation of seasonal hours.

6: The smudges at the beginning of this line may represent an aborted attempt at writing “3”.

This is the only line which includes an explicit designation of *hrw*, “day”. See OMM 844, line 1, which contains *sw*, “day”.

The symbol for “20” is difficult to read and “4” cannot be conclusively ruled out. If 20 is accepted, this numeral may have been intended to be read with the following sign as “21”.

[5] For a review of rhetorical structure theory, see Taboada and Mann, (2006a). For its applications, see Taboada and Mann, (2006b). Particular thanks are due to Jacques Virbel, who has promoted the study of enumerations outside the domain of linguists.

If the traces at the end of the line, , are read as “19,” this number is out of order and difficult to explain. Alternately, the sign may be read phonetically, and the final traces could be interpreted as the lotus-determinative. This line may contain a writing of *ḥʿy*[6] written in Coptic as ϣⲁ[7] and translated as “festival”. By itself, this reading is not compelling, but the same writing, , appears on OMM 796, line 2. In the second instance, the appearance of “*2.t*” implies that the word is feminine.

7: This fraction is difficult and looks most like 1/13, though one expects 1/16 from the scheme for the calculation of seasonal hours proposed later. The fraction is introduced in a complete sentence, as in OMM 844, lines 3 and 4.

OMM 796

2: The sign possibly represents a dittography of “10” with part of the fraction having been destroyed, but the similarity of this line with OMM 170, line 6, seems to contradict this interpretation. According to the proposed scheme of seasonal hours, the fraction 1/13 is expected. This reading may be restored if the sign is accepted as a dittography.

3: The second digit of “21” is damaged by a scrape, but sense prevents it from being read as “*šʿ*□.

6: The first number after the month is obliterated. Presumably, some number between 1 and 9 filled the gap. The number “3” seems to fit the traces. After “*šʿ*,” 5 is written, presumably as a truncation of 25. Alternately, “*šʿ*” may be a poor writing of 20 with an extraneous stroke.

8: At the beginning of the line, 15 is written. The sense of the interval indicates this was probably in error for 25. Some portion of the end of the line has broken away. After the preposition, the fraction indicator is expected but cannot be found. Presumably the portion of the fraction written as stood on line 8.

9: Because 4 appears independently and is out of order with the list of days, this number ought to conclude the fraction broken off line 8. Thus, the fraction may be restored as 1/14.

OMM 844

1: This line includes an explicit designation of *sw*, “day”. See OMM 170, line 1, which contains *sw*, “day”. The broken sign at the end of the ostracon is probably *ʿrḳy*.

[6] Erichsen, (1954, 293).
[7] Crum, (1939, 543-544).

Calendars for Divination: Hemerology in Greco-Roman Egypt

The determination of days as lucky, unlucky, suitable or unsuitable for a certain purpose constitutes a common human endeavor. Such determinations, however, varied in antiquity, and only a few of these determinations appear in Egyptian sources. A survey of the hemerological texts from Greco-Roman Egypt clarifies the local and temporal context of these ostraca from Medînet Mâdi and permits a few glimpses of their cultural legacy.[8]

Babylonian Precursors (2nd Millennium)

The genre of hemerology (and the related genre of menology) probably originated in the Assyrian Empire (1305-612 B.C.) of Mesopotamia as a "kind of calendrical supplement to the series *Šumma ālu* and *Enūma Anu Enlil*,"[9] although close parallels to the genre also appear in Hittite texts from the later part of the second millennium.[10] Even though hemerologies are so numerous among cuneiform sources that a Mesopotamian origin seems probable, nearly contemporary Egyptian sources from the New Kingdom also include calendars of lucky and unlucky days (hemerology; *Tagewählerei*).

New Kingdom Sources (2nd Millennium)

The earliest Egyptian hemerological text, P. Cairo 86637, preserves a list of every day of the Egyptian year.[11] Each date is followed by a short bipartite prediction. The first part consists of such words as *nfr,* "good" and *ʿḥꜣ*, "dangerous". Then, a prediction concludes each assessment. Bad omina are written in red ink to symbolize their severity.[12] A brief citation serves as an example: "*2. Monat der Überschwemmungszeit. Tag 23. Gut! Gefährlich! Gefährlich! Jeder, der an diesem Tag geboren wird, stirbt wegen eines Krokodils"*.[13]

Naos of the Decades (4th C. B.C.)

More evidence appears in the Naos of the Decades, a shrine of 1.78 meters of height made of black granite.[14] Parts of it were found independently on land and in the sea. They are stored at the Louvre in Paris and in the Greco-Roman Museum in Alexandria. More pieces could have been retrieved by the underwater mission of Franck Goddio in the bay of Abuqir.[15]

8 Although the iatromagical oracle of the 36 decan stars and the Tabula Aristobuli published by Gundel, (1936) come close to the sources presented here, these two divinatory systems will be disregarded here for the lack of a calendar.

9 Rochberg, (2004, 49).

10 Riemschneider, (1970, 44, n. 39).

11 For a translation, see the edition of Leitz, (1994). For the text, see Bakir, (1966). For a study of the genre, see Drenkhahn, (1972, 85-94). For a use of this calendar in a literary text (*The Tale of Sinuhe*) as a narrative device and a rhetorical feature of fiction, see Fischer-Elfert, (2006, 23-27).

12 Griffith, (1972, 88).

13 Leitz, (1994, 93-94).

14 The common title of the naos is a misnomer. A decade is a ten-year period of time. The Egyptian celestial division is a decan.

15 For a short introduction and photographs, see von Bomhard, (2006, 46-53).

The Naos of the Decades was erected under the reign of Nectanebo I (ca. 380-362 B.C.) for the god Shu-Sopd, whose statue, according to the inscription, stood inside the naos in form of a golden lion. On the outer surface of the naos, a calendar was carved into the stone. This calendar divided the Egyptian year into 37 parts – that is, 36 decans which begin with the heliacal rising of the 36 decan stars and an additional column for the five epagomenal days. Next to the remarks about the positions of the decans in the sky, another text records the king's offerings for the day. This composition indicates that the Naos of the Decades was used as a festival calendar in a local temple. Another column contains descriptions of historical events in a slightly prophetical style.

Festival Calendars in Temples (Ptolemaic Era)

Several inscriptions on the temple walls at Tebtunis, Medînet Habû, Philae and elsewhere in Egypt could also be categorized as calendars. In these inscriptions, certain days are enumerated as local and regional festival days.[16] Briefly stated, the hemerologies in these inscriptions use specific dates of the Egyptian year and apply to the whole lunar and solar cycle. However, these hemerologies do not rule out some days or emphasize other days by a special system or mode of designation unknown to us.

P. Brookl. Dem. 147 (Ptolemaic Era)

The purpose of the ostracon known as P. Brookl. Dem. 147 remains unclear, but its similarity to the series found at Medînet Mâdi ought to be noted.[17] The first two lines provide a title and a date – "Year 22, Thoth, day 10. The times of illumination before the Osiris *Ns-pꜣ-mtry*" – but neither piece of information is explicit. Moreover, the date does not name a particular ruler, though it may be surmised through paleographical considerations that a Ptolemy was intended. Unfortunately, the meaning of the phrase *tiꜣ.w n sḥt*, "times of illumination," is unclear. Taken literally, the words seem to imply some reference to seasonal hours, but the list contains only specific days introduced by *sw*. These days must be the "times of illumination". Perhaps, the phrase refers to a series of days similar to those on the ostraca of Medînet Mâdi, but the fact that the "illumination" occurs before a deceased individual seems to indicate some type of funerary cult. Like the Medînet Mâdi series, the list includes epagomenal days, but in this case the primary division of the list is not the twelve months of the year. Rather, P. Brookl. Dem. 147 first divides the year into the three Egyptian seasons, each of which is subdivided into four months containing the respective days. The last line is apparently missing. Furthermore, no festivals appear in the list, and the general purpose remains elusive.

P. Vienna inv. 12006 (ca. 30 B.C. - A.D. 50)

The Demotic papyrus Vind. D 12006 preserves a hemerology for mantic purposes.[18]

[16] For Greco-Roman festival calendars generally, see Grimm, (1994). For calendar dates on individual monuments, see Spalinger, (1995) and (1996, 25-40); and el-Sabban, (2000).

[17] For the edition of the ostracon, see Hughes, (2005, 56-57).

[18] The oldest instance of this family of texts is preserved in Berlin Museum (P. Berl. 23057). This papyrus was written in hieratic script but had been composed according to Demotic grammar. Stadler assigns this piece to the 30th dynasty (c. 380-343 B.C.). See Stadler, (2004, 236-240). As the title indicates, Stadler

Difficult to read because of numerous lacunae and its poor state of preservation, this papyrus nonetheless preserves the structure of a hemerology similar to other hemerologies which appeared later in the historical record, such as the *Sortes Astrampsychi* or the *Homeromanteion*. Fortunately, the identification and publication of this early example proves the genre existed among Demotic literature. On this early example, the divisions applied to the days include the technical terms <*n*> *t3wy*, "in the morning;" <*n*> *rhy,* "in the evening;" *wš,* "not at all" (lit. "break"); and <*n*> *nw nb*, "anytime".

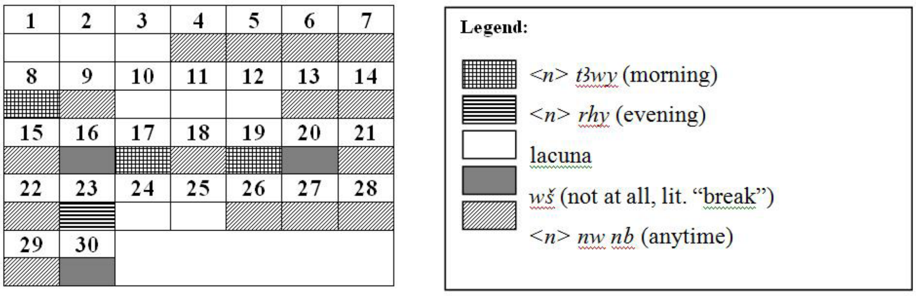

Fig. 1 - The Calendar of Lucky and Unlucky Days of P. Vind. D 12006

Other Texts from Medînet Mâdi (2nd C. A.D.)

The birth notes from Medînet Mâdi, including those published by Donata Baccani, Rosario Pintaudi, and still others to be published by Menchetti, present other points for comparison.[19] In these texts, a series of numbers and a time of the day (either *n grḥ*, "at night" or *n mtrỉ*, "during the day") stand for the year, month, day and hour for which the horoscope was cast. These cryptic abbreviations written on ostraca could have served as memoranda for mantic specialists. With the birthday, a scribe trained in astronomy could have prepared planetary positions, and an astrologer (who may or may not have been a different person) could have interpreted the fate of the petitioner, perhaps orally. Unfortunately, we are scarcely informed how this practice was executed in Egypt. These notes could have also been used to indicate the appropriate times for magical rituals. In PGM 3, 275-81, specific astronomical conditions are recorded as good for particular kinds of divination. For example, when the moon is in Gemini, the petitioner is encouraged to perform binding spells.[20]

also presents P. Vind. D 12006. This papyrus and the somewhat shorter parallel P. Vind. D 12194 were composed in the Augustan Era. To this edition, add his preliminary discussion in Stadler, (2002, 108-25). To the edition, add the review by Quack, (2005, 174-79) and the answer of the editor in Stadler, (2006).

[19] For the birth notes, see Baccani, (1989) and (1995). To this add, Menchetti and Pintaudi, (2007). Further birth notes will appear by Menchetti (forthcoming). At least one more ostracon with three birth notes from Medînet Mâdi has been misidentified, particularly OGN 65 in Pintaudi and Sijpesteijn, (1993, 83). This ostracon may be rendered as: "(Year) 6, (month) 2, (day) 20, (hour) 3 (of the) d(ay). (Year) 5, (month) 5, (day) 2, (hour) 8 … (Year) 8, (month) 2, (day) 6, (hour) 12 (of the) d(ay)," with no changes to the text. Some changes may be appropriate for the second birth note.

[20] See Preisendanz, (1973-74) and Betz, (1992). Binding spells are intended to immobilize human beings in order to keep a woman from running away (binding love spells) or to prevent a business rival from enacting the transfer of goods, or in sports to "freeze" the bones and muscles of an athlete.

Papyri Graecae Magicae (2nd C. B.C. - 6th C. A.D.)

The so-called *Papyri Graecae Magicae*[21] collected by Karl Preisendanz and others contain the closest parallels to the information presented in the present series from Medînet Mâdi. In PGM 7, lines 155-67 (written between the 3rd and 6th C. A.D.), a list of the thirty days of the Egyptian lunar month is given with the addition δι' ὅλης ἡμέρας, "the whole day; ἕωθέν, "early morning/dawn," μεσημβριας, "noon;" δείλης, "afternoon/evening;" or μὴ χρῶς, "not at all," lit. "do not use". The title "Days and hours for divination" heads this list, which is compiled with the *Homeromanteion*, other magical spells and requests for incubation on the magical papyrus from the British Museum London no. 121 (= PGM 7). No further instruction for using this calendar appears, but it could be assumed that it belonged to a divinatory technique by which a day was specified for rituals such as consulting an oracle or requesting a dream. Because only five lines of Greek text separate this calendar from the *Homeromanteion*, it could be assumed that PGM 7 served as a manual for a diviner specialized in hemerology.

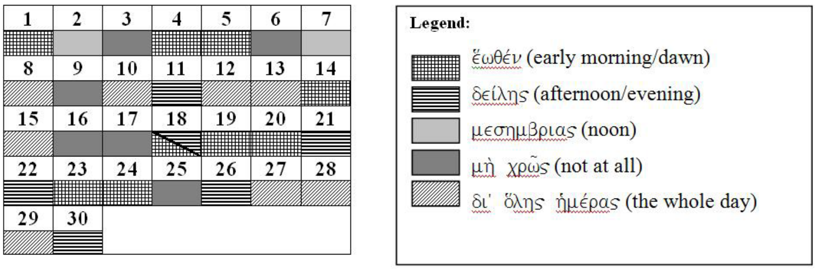

Fig. 2 - The Calendar of Lucky and Unlucky Days of PGM 7, 155-67

Another example from more than 100 lines later in the same Greek magical papyri (PGM 7, lines 272-83) runs closer to the series from Medînet Mâdi, extends through the whole of the Egyptian year, and is even shorter in its formulations.

"*Thoth: 1, 4, 12, 13, 22. Phaophi: 2, 4, 10, 19, 20. Athyr: 7, 8, 9, 17, 18, 23, 27. / Choiak: 5, 6, 13, 15, 16, 24, 25. Tybi: 3, 4, 12, 24, 26. Mecheir: 1, 2, 10, 14, 19. Phamenoth: 7, 8, 9. Pharmouthi: 5, 6, 14, 15, 20. / Pachon: 3, 4, 12, 13, 21, 26, 28. Pauni: 1, 2, 10, 11, 15, 20. Epeiph: 7, 8, 9, 14, 18, 19, 22. Mesore: [10, 14,] 20, 23, 24, 25".*[22]

[21] The first edition of the three volumes of the Papyri Graecae Magicae (henceforth, PGM) appeared in 1928-31. A new publication with additional texts was compiled by Albert Henrichs (1973-74) from the notes of the late Preisendanz. The third volume, the index with thematical grouped entries, was compiled by Preisendanz in collaboration with Erich Diehl and Sam Eitrem in 1941. This book features the numbers of PGM 1 and 2 as well as 25 new texts. Unfortunately, this Teubner publication (Leipzig / Berlin) was never fully released due to the bombing of the printing house during the Second World War. However, some copies survive and we are very grateful to Heinz-Josef Thissen who shared his copy with us. For magical papyri written not only in Greek (the focus of Preisendanz and Henrichs) but also in Demotic, Hieratic, (Old) Coptic, Nubian and others, further texts have been published. For a helpful overview, see Betz, (1992). Henceforth, the Papyri Demoticae Magicae texts are abbreviated as PDM.

[22] See Betz, (1992, 124).

The translator of this passage, William C. Grese, classified the text as "an Egyptian calendar of months and days unsuitable for magic operation". Presumably, this conclusion was drawn from the evidence in PGM 7, lines 155-67, in which four temporal assignments deal with the times of day suitable for divination and with only one designation not being suitable at all. In this hemerology, three to seven days of a month are specified, leaving over 75% of each month, if Grese is right, for mantic actions to take place.

In many instructions for spells and rituals in the magical papyri a certain date is generally given. For example, the Demotic love spell PDM 14, line 786 (written in the 3rd C. A.D.), instructs "You do it on the fourteenth of the lunar month".[23] The "Lunar spell of Klaudianos," a love spell which relies on incubation, advises the removal of a lunar ointment "late at night, at the 5th hour".[24] Clearly, both dates and times were important to a range of mantic practices.

Hemerology for the *Homeromanteion* (3rd-4th C. A.D.)

As noted above, PGM 7 preserves both the *Homeromanteion*, a system of divination using quotations from Homer's works as a handbook for answering a petitioner's request and a hemerology.[25] In order to use the *Homeromanteion,* the petitioner first throws a regular six-sided die three times (or three dice at once). The petitioner finds the "answer" to his request in a list of Homeric quotations written on papyrus, using the number and sequence of his dice throws as an index. For instance under the entry 3-4-6, the text of the *Homeromanteion* reads: "*You will not kill me, since I am certainly not subject to Fate"*.[26] All three preserved *Homeromanteia* – PGM 7, lines 1-148, Suppl. Mag. 2, 77 and P. Oxy. 56, 3831 – seem to have been derived from a common source.[27] The last example, P. Oxy. 56, 3831, contains a hemerology to be used before casting the die or dice. This hemerology is constructed along similar lines as the hemerology of the PGM 7, lines 155–67 – only in this instance there are five temporal divisions and μὴ χρως denying the possibility of an enquiry at all. Because of these similarities, because all the *Homeromanteia* seem to derive from the same source and because of the close proximity of the hemerology to the divinatory handbook, some consideration that this practice appears in PGM 7 seems warranted.

23 Betz, (1992, 236). We have collected about 40 examples indicating a special day and/or hour.

24 Preisendanz, (1973-74), PGM 7, 862-918, line 875; Betz, (1992), 141-142.

25 Other *Papyri Graecae Magicae* cite Homeric verses, namely PGM 4, 469-70; PGM 4, 820-34; PGM 4, 2145-2240 (under the title "*divine assistance from three Homeric verses*"), PGM 17b; PGM 22a and PGM 23. All these instances are Greek and, in most cases, spells to relieve the petitioner from a medical problem. The forty-third spell in Meyer and Smith, (1994) comes from a Coptic medical handbook with spells that quote Homer (lines 41-44; P. Mich. 136). These examples invoke the ancient author's prestige and use it to "sanctify" the power of the spell but were not part of a larger ritual text such as the *Homeromanteion* with a calendar in the beginning.

26 Il. 22, 348. See Betz, (1992), 115, translation by H. Martin.

27 For editions, see Preisendanz, (1973-74) and Betz, (1992) *ad locum*, Daniel and Maltomini, (1992, no. 77) and Sirivianou, (1989, no. 3831). PGM 7 was written between the 3rd and 6th C. A.D.; Suppl. Mag. 2, 77 was written between the 2nd and 4th C. A.D.; P. Oxy. 56, 3831was written in the 3rd or 4th C. A.D.

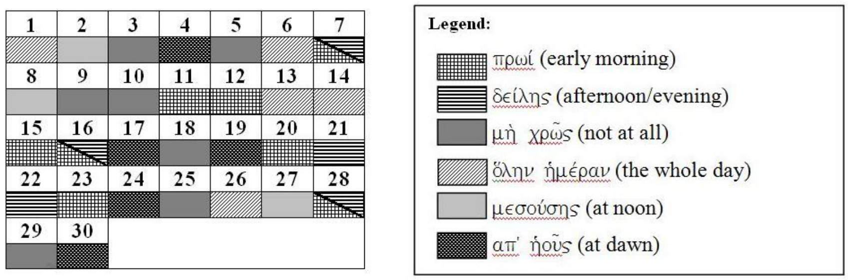

Fig. 3 - The Calendar of Lucky and Unlucky Days of the *Homeromanteion* (P. Oxy 56, 3831)

Sortes Astrampsychi (3^{rd}-6^{th} C. (?) A.D.)

A similar calendar, in Greek, may once have appeared in the prologue of the oracle for divination by lots, named the *Sortes Astrampsychi*, or "the lots of Astrampsychos," after its fictional creator Astrampsychos, a mythical magician of supposed Persian or Egyptian origin.[28] Thirteen papyrus fragments from the third through sixth century A.D. preserve parts of this text. The majority of the evidence, however, comes from thirteen medieval codices. In this oracle, the petitioner chooses a question from a catalogue of 92 stock inquiries dealing with nearly every aspect of life. Then, he determines the appropriately connected lucky (or unlucky) number and finds his individual lot from among more than 1,000 answers, using a complicated mathematical system. The answers are grouped in decades and arranged thematically in the book, which also includes some fake (!) answers. Unfortunately, the divinatory hemerology in the prologue is preserved only in the manuscripts from the 13^{th}-16^{th} century. In these sources, detailed instructions about how to use the *Sortes Astrampsychi* are given by the "author" himself in the form of a letter to a king Ptolemy of Egypt, (presumably, Ptolemy I, 306-283 B.C.). In this letter, Astrampsychos claims that he obtained the oracle from the Greek mathematician Pythagoras (6^{th} C. B.C.) and that the oracle assisted Alexander the Great (336-323 B.C.) during his conquests.

This calendar exists in two versions. The first is similar in structure to the calendar which appears in PGM 7 lines 272-83 and assigns an ordeal to every one of the 30 days of the Egyptian month. The second calendar was subjected to Christian interpolation and contains only the seven-day week. The pagan version depicted here[29] strongly corresponds to the format of the hemerology from Medînet Mâdi.

28 For the edition of the texts, see Stewart, (2001). For an English translation, see Stewart and Morrell, (1998, 287-324). For further reference, see Naether, (forthcoming).

29 As preserved in the Codex Erlangensis A4, B 1-3 published by Brodersen, (2006). In the discussion of the lunar calendar in B 1, the author reports that particular hours on Wednesdays, Fridays, Saturdays and Sundays are days on which to consult the oracle.

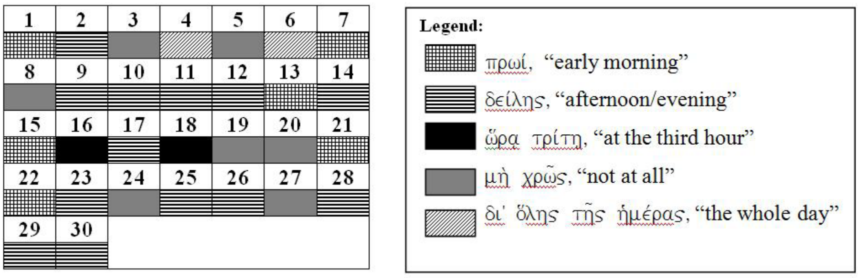

Fig. 4 - The Calendar of Lucky and Unlucky Days of the Sortes Astrampsychi

P. Kellis 1.82 and 83 (4th C. A.D.)

These two lists of days, written in Greek, may preserve another possible means of discerning days for divination. P. Kellis 1.82, a wooden board from the 4th century A.D., includes not only distinctive determinations for the day but also the hour suitable for rituals.[30] In addition, the board contains two holes in its lower right side through which this board was presumably attached to other wooden boards, making a codex. The list on P. Kellis 1.83 contains a comparable, though fragmentary hemerology on papyrus. The method used to determine the days in P. Kellis 1.82 and 83 might have been similar to the method applied in the Medînet Mâdi series.

Lunaria and Selenodromia (Until Early Modern Times)

Hemerologies were also prepared for the 30 days of the lunar month. These lunar omina appear in Greek, under the title σεληνόδρομια, and in Latin are called *lunaria*.[31] The Latin *lunaria* have been preserved in several medieval manuscripts written between the ninth and fifteenth century, but Svenberg in his excursus about the *lunaria* argued that these texts reflect a much older divinatory method. Svenberg considered Mesopotamia and Egypt as the possible origin of these texts but speculated about Jewish influences. Authors of the Roman imperial and Byzantine period mention *lunaria* and selenodromia in different contexts. Presumably multiple versions of *lunaria* circulated in antiquity. The genre was preserved through Christian interpolations, and other divinatory genres like dream books bear striking resemblances to these lunar *ominae*.[32]

A *lunarium* assigns to each day the success of a project, the character of someone born on this day, the chances for recovery from illness, the security of maritime travelers, or the importance of last night's dreams. Specifically, the genre of lunaria also contains *zodiacal lunaria*. Svenberg additionally mentions practices that modern anthropologists and sociologists have relegated these studies to the genres of "Bauerpraktik" and folklore.

30 See Hoogendijk, (1996), 216-8. For the full edition, see Worp, (1995).

31 For a modern (Swedish) edition, see Svenberg, (1936).

32 See Svenberg, (1936), 154-170, especially 160, n. 3. Svenberg also notes a related passage in Virgil's *Georgics* and speculates about the lunar content of Hesiod's *Works and Days*. For further studies, see Weinstock, (1949).

Non-Divinatory Calendars

Calendars appear frequently among the papyri from Egypt. However, the majority of these texts are simple lists of the months and were perhaps school texts produced as aids to memorizing the Egyptian months in the correct order and practicing the orthography of month names.[33] Other, less common, instances of calendars in Greco-Roman Egypt include lists of correspondences with other calendrical systems such as the Roman, Greek or Bithynian calendars[34] or calendars of Christian saints.[35] The parapegmata, a genre of meteorological and astronomical text organized by calendar day, are found copiously in Greek. These texts are only as divinatory only as the practice of weather prediction.[36]

Role of Hemerologies

After menologies, which divide the year into months suitable for various undertakings, hemerologies present the next primary division of the calendar. For public religious purposes, subdivisions were usually no smaller than one day. Thus, the Naos of the Decades, the festival calendars found on temple walls, P. Brookl. Dem. 147, and P. Kellis mark only days. However, as early as the New Kingdom, some texts sought to subdivide the day further.[37] Particularly, P. Cairo 86637, P. Vind. D 12006, the *Sortes Astrampsychi,* the *Homeromanteion*, and the spells of the PGM all represent techniques of divination and divide the day into various subunits. Although some birth notes of Medînet Mâdi can

[33] For P. Mon. Epiph. 2, 617 from the 1st c. A.D, see Hasitzka and Harrauer, (1990, no. 250, 177-78). For P. Strasb. gr. 98 (=SB 26, 16597; 16601) from the 2nd c. A.D, see Fournet (2001, no. 1, 160-162; no. 6, 167; and fig. 7). For a 3rd c. A.D. example, see P. Cair. Zen. 4, 59754. For P. Würzb. K 1020, a wooden tablet from 4th or 5th c. A.D, see Brashear, (1986, 8-9). For P. Berl. 1080 (= SB 26 16521), another text from the 4th or 5th c. A.D, see Poethke, (2000, 160-161). For P. Vind. G 1090, a 5th c. A.D. source, see Harrauer and Sijpesteijn, (1985, no. 115, 106–07); for P. Yale CtYBR 3678, a 5th c., wooden tablet, see Duttenhöfer, (1997, 244-250). The supposed "school texts" enumerated in J. Debut's list in ZPE 63 (1986, 257-8, nos. 98-101): P. Cairo inv. JdE 65445; P. Fay. 135 vo.; O. Mon. Epiph. 2, 618 and P. Cairo Zen. 4, 59754 vo.

[34] J. Kramer described P. Fay. 135 vo. as a "Glossaria bilinguia in papyris et membranis reperta". The text is available on-line at http://wwwapp.cc.columbia.edu/ldpd/app/apis/item?mode=item&key=columbia.apis.p389. Gundel (1958, 13-19) presents a Latin-Greek glossary of names of Roman and Egyptian months in Greek alphabet from the 4th c. A.D. See also O. Brit. Mus. Copt. 1, p. 32, no. 2 (pl. 17, prayer with Latin and Coptic months with apparently no connection). For a concordance of the Julian and Alexandrian month names, see P. Iand. 654 vo. (= SB 6, 9529). For a 6th or 7th c. A.D text (=SB 20, 14302 and 15179) with Egyptian months on one side and Bithynian months on the other, see Rea (1992).

[35] For a 7th or 8th c. A.D. calendar of saints, see P. Vind. G. 14034 in Papaconstantinou (1993). For a 6th or 7th c. A.D. Coptic list of saints' days, see P. Iand. 318 (=SB 18, 13140). For a precursor from the 6th c. A.D., see P. Oxy. 11.1357 (= P. Lond. Lit. 233), republished by Papaconstantinou (1996). This genre even includes pagan precursors. For a fragmentary 3rd c. A.D. list of pagan festivals, see P. Oslo 3.189. For a calendar of cult offerings from the 2nd or 3rd c. A.D., see P. Oxy. 31.2553. For a 2nd c. A.D. religious calendar for imperial cults, see P. Oslo 3, 77(= SB 5, 8253) in Eitrem and Amundsen (1936). For the 1st c. A.D. "calendar of Gaius," (= P. Oxy. 55, 3780), see Begert (1996, 29, n. 53). Of particular interest is the 1st or 2nd c. A.D. hieratic P. Carlsberg 2, preserved at Tebtunis only in small fragments, which once formed part of a larger list of decans. See Osing (1998, 222-258). For an unpublished calendar of feasts, see Kaplony-Heckel (1986, 86, no. 240 ro).

[36] For a thorough summary of the parapegmata, see Lehoux, (2007).

[37] For a recapitulation of such divisions among Greek sources purporting to have Egyptian precedents, see Williams, (2007), who traces these techniques to Mesopotamia.

be directly linked to horoscopes, others of them may have been determined for magical or mantic purposes. These divisions of time – by day and even by specific hour within the day – were also used for mantic and religious purposes.

Seasonal Hours in Greco-Roman Egypt

Astronomical Background

The seasonal change in the length of daylight results from the fact that the axis about which the earth rotates is neither perpendicular nor parallel to the plane in which it revolves about the Sun. If the axis were perpendicular to the plane which contains the orbit of the Earth, night and day would be equal throughout the year. If the axis were parallel to the plane, half of the Earth would be continuously illuminated and half would be plunged into darkness. As it happens, the axis is slightly inclined, a fact which produces variations in the length of daylight during the orbit of the Earth around the Sun. The change in daylight depends both on the observer's position on the globe and the time of year.

At the equator, all days and nights are of equal length. The path of the Sun inclines to the north or south throughout the year, but because the rising and setting points remain due east and west, the length of daylight never varies. The farther an observer moves to the north or south, the greater the variation among the rising and setting points of the Sun. Thus, the farther an observer is displaced from the equator, the greater the difference among the seasonal hours. The two extremes – the North and South Poles – each spend half of the year illuminated and half of the year in darkness.

From a geocentric perspective, the seasonal variation of daylight may be explained by changes in the path of the Sun about the Earth. The plane in which the Sun orbits the Earth oscillates throughout the year. At the vernal equinox, the Sun rises and sets at due east and west with the result that day and night are equal. During spring in the northern hemisphere, the rising and setting of the Sun move farther north until they reach their maximum displacement on the summer solstice. In these months, the Sun spends a greater amount of time above the horizon than beneath it. After the summer solstice, the points on the horizon at which the sun rises and sets move south. Day and night are again equal at the autumnal equinox, but the rising and setting points continue to move south until their maximum displacement on the winter solstice. During winter in the northern hemisphere, the Sun is displaced to the south and has a greater portion of its orbit about the earth beneath the horizon. After the winter solstice, the risings and settings move north again.

Seasonal Hours in Babylonian Sources

The earliest Babylonian texts treating the seasonal change in the length of day light probably derive from Egyptian sources. The earliest evidence is a fragment of an ivory prism from Nineveh (BM 123340), made some time before 612 B.C., contains a monthly adjustment to the length of daylight. Although the rules by which the numerical tables were constructed are not yet perfectly understood, Fotheringham and Smith have shown that the prism discusses the length of seasonal hours "and the ratio of the longest to shortest length of daylight is 2:1".[38] The ratio of 2:1 occurs again on the better-understood tablet K2077+3771+11044 + BM 54619, which explicitly declares itself to have been written in 650 B.C. Both texts use a period of day and night (nychthemeron) equal to 24 hours and probably represent a Babylonian adaptation of Egyptian techniques. Although the Babylonians are generally accorded a high degree of astronomical competence, the 2:1 ratio is more appropriate for the seventh classical clime, the mouths of the Borysthenes, in the modern Ukraine.

Seasonal Hours in Egyptian Sources

A thorough survey of the seasonal hours in Egypt has been prepared by Marshall Clagett.[39] Clagett synthesizes previous studies and draws heavily on Borchardt.[40] Clagett's scope is encyclopedic and he treats shadow clocks and the art of determining time by the decans. These methods are observational and do not relate directly to methods presented in this series of ostraca. For an understanding of the context of the Medînet Mâdi calculations, only the mathematical approaches require consideration. Moreover, because of the late date of the ostraca, the present survey ought to be extended to encompass some portion of the Greek material.

Middle Kingdom Origins

The earliest evidence that Egyptians tried to account for the seasonal differences in hours comes from the biography of Amenemhat, an official who lived under the reign of Ahmose, Amenhotep I, and Thutmosis I (approx. 1500 B.C.). In his mortuary inscription, Amenemhat claims that "*while reading in all the books of the divine word, [he] found the night of wintertime to be 14 [hours] when the night of summertime is 12 hours*".[41] Sadly, the books of "the divine word" which Amenemhat claims to have read have not survived. Some ambiguity surrounds the use of the word "hours". As the biographical inscription notes, the hours of summer and winter are not equal. Informed by an outflow water clock from Karnak, Clagett has proposed that the text ought to be read as "I found the scale of the longest night in wintertime to be 14 fingers long if the scale of the shortest night of the summertime is 12 fingers, with each finger marking one hour".[42]

The ratio of 14:12 recurs in an outflow water clock made in the reign of Amenhotep III (~1400 B.C.). The rim of this water clock contains the names of the months. These names are associated with scales of hours contained on the inside of the clock. No allowance is made for the epagomenal days. The shortest scale corresponds to 2 Shemu, the month which presumably contained the summer solstice and thus the shortest nights.

The Egyptian year of 365 days with no intercalary days did not stand in fixed relation to the seasons. Because the month of 2 Shemu contains the shortest hours, it is possi-

[38] See Pingree and Hunger, (1999, 112).
[39] See Clagett, (1995, 48-106).
[40] See Borchardt, (1920).
[41] *… m šdi.t m sš.w nb n md.t nṯr… 14, ỉw grḥ n šmw m wnw.t 12*. See Schiaparelli, (1892, 203-208).
[42] See Clagett, (1995, 461).

ble to determine that water clock was more accurate for the reign of Amenhotep I, than for that of Amenhotep III. By the months which contained the solstices and equinoxes, Neugebauer proposes a date of composition between 1640 and 1520 B.C. Thus, the internal hourly scales conform either to a water clock from which this vessel was copied or to a scheme of measurement which had been thoughtlessly applied. In either case, the spacing of the hourly divisions indicates that the ratio of the longest day to the shortest day was about 14:12.

From a comparison of the measurements of each scale, Borchardt proposed that the shortest nocturnal hours in 2 Shemu correspond to the amount of water measured by 12 fingerbreadths. Each successive month increased the amount of water by 1/3 fingerbreadth until a maximum of 14 fingerbreadths in 4 Akhet. Although this ratio differs from the astronomically expected 14:10, the result is considerably better than the contemporary Babylonian approximations. Nonetheless, a scheme containing a uniform monthly change in the length of daylight agrees only roughly with the actual change in daylight which varies more slowly at the solstices and more quickly at the equinoxes.

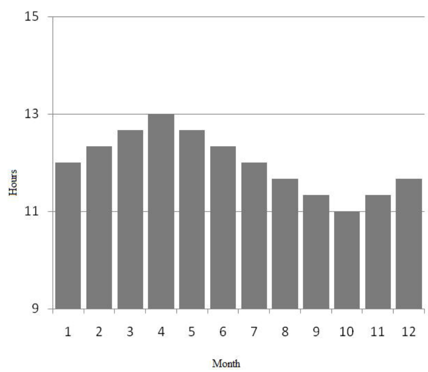

Fig. 5 - Scheme of Seasonal Daylight in Karnak Water Clock of Amenhotep III

New Kingdom Continuation

P. Cairo 86637, introduced in the section concerning hemerologies, also contains a scheme for reckoning the length of daylight. According to Bakir, the "examination of certain [hieroglyphic] signs has proved that the date of the document could be that on *vs.* xix, i.e. Ramesses II".[43] Leitz takes this date as the *terminus ante quem*.[44] Although the writing of P. Cairo 86637 may be assigned some date before Ramesses II (1279–1213 B.C.), the months containing the solstices and equinoxes indicate that the scheme was accurate for a slightly earlier period, particularly sometime between 1400 B.C. and 1280 B.C. Like the Karnak water clock, P. Cairo 86637 assumes a regular monthly change in the length of daylight. The facts that the solstices and equinoxes are displaced by a month and that the monthly change in the length of daylight is constant pale in comparison with the griev-

[43] Bakir, (1966, 6).
[44] Leitz, (1994, 6).

ously poor ancient estimations of the length of the longest and shortest days. Here, the ratio of longest to shortest day is 3:1, a ratio which is appropriate for no Egyptian locality. Rather, Cleomedes cites exactly such a ratio as appropriate for Britain.[45] Neugebauer and Parker[46] have suggested that perhaps the longest day is the complement of the shortest night of 12 decanal hours. While the shortest night of 12 decanal hours does roughly agree with 6 equinoctial hours, the longest night of 12 decanal hours corresponds to about 8 1/2 equinoctial hours.

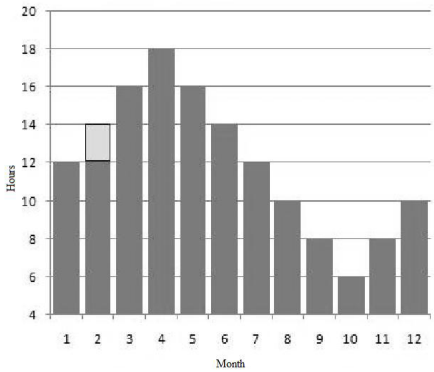

Fig. 6 - Scheme of Seasonal Daylight of P. Cairo 86637

Late Period Fragments

Sometime during the Twenty-Sixth Dynasty (672 to 525 B.C.), a scheme which equated the lengths of day and night with equinoctial hours was inscribed on a plaque at Tanis.[47] This fragmentary text also contained information about decans. Unlike other Egyptian determinations of the length of daylight, this text contains two entries for each month, one on the first day of the month, the second on the fifteenth day of the month. An obvious error assigns 22 hours of daylight to days 1-15 of 2 Shemu, and perhaps the shortest days of 9 1/3 hours on 15-30 of 3 Shemu ought to be emended to 9 2/3 hours. More importantly, the lack of symmetry hampers any serious attempt at reconstruction. In the graph below, the seventh entry indicates the longest days on 15-30 of 1 Peret. Thus, columns 4 and 10 ought to be equal. Also, the nineteenth entry indicates the shortest days on 15-30 of 3 Shemu. Thus, columns 22 and 16 ought to be equal. Likewise, columns 23 and 15 ought to be equal.

The scheme suffers further if the lengths of daylight for dates separated by 6 months are assumed to sum to 24 hours. In only four instances are both lengths of daylight preserved for two dates separated by 6 months. The first instance, for 15-30 of 2 Akhet and 15-30 of 4 Peret (Columns 1 and 13), do yield 24 hours. Perhaps the scribe was aided here by the fact that these dates contained the equinoxes. The second pair, 1-15 of 4 Akhet and 1-15

[45] *Caelestia* 1.4.197.
[46] Neugebauer and Parker, (1960, 120).
[47] For the *editio* princeps, see Clère, (1949), who claims the inscription is in the Cairo Museum.

of 2 Shemu (Columns 4 and 16), is complicated by scribal error. Neither solution proposed by Clère, either 11 or 10 1/2 1/6 completes 13 3/4.[48] Moreover, 10 1/4 is impossible to restore. In the third pair of dates, 1-15 of 3 Peret and 1-15 of 1 Akhet (Columns 10 and 22), the sum exceeds 24 hours by half an hour. In the last case, 15-30 of 3 Peret and 15-30 of 1 Akhet (Columns 11 and 23), the lengths of daylight fall short of 24 hours by 5/12, slightly less than half an hour. Perhaps the table of seasonal hours from Tanis represents little more than a cultural memory of seasonal hours, which was once understood in the past but now having long since been systematized and memorized was prone to the repetition of copyists' errors and reconstructions.[49]

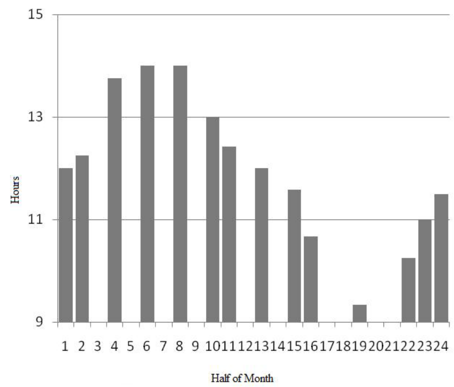

Fig. 7 - Scheme of Seasonal Daylight from Tanis

Ptolemaic Era Water Clocks

In the Ptolemaic period, Egyptian scribes made an attempt to approximate more closely the scheme for the change in seasonal hours. In these instances,[50] the scribes applied the scale of 12 fingerbreadths to the months with equinoctial days, rather than to the month with the shortest days. In the month before and after the equinoxes, the length of daylight changed by a full fingerbreadth. In the preceding months, the scribes approximated the change in daylight by 2/3 of a fingerbreadth. In the months surrounding the solstices, the scribes allowed a change of only 1/3 of a fingerbreadth. This scheme of accounting for the seasonal change in the length of daylight preserves symmetry and yields a nice approximation. In no case is any special consideration given to the epagomenal days.

[48] Clère, (1949, 7-9).

[49] For an introduction to cultural memory (*Kulturelles Gedächtnis*), see Assmann, (1996). For a discussion of lists and tables with such a framework, see especially Assmann, (1996, 111-114).

[50] For the typical scheme, see Borchardt, (1920, 13). This scheme governs Water Clocks 2, 3 and 4. For the introduction to these particular water clocks, see Borchardt, (1920, 7-8). There exist other water clocks too broken to permit the reconstruction of the entire scheme.

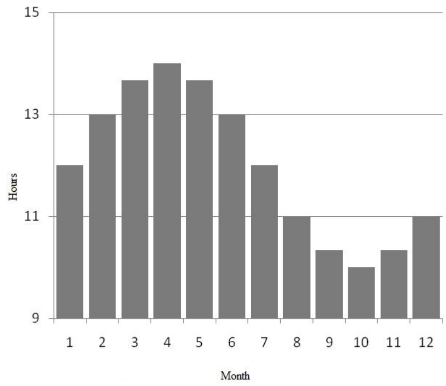

Fig. 8 - Typical Scheme of Seasonal Daylight during the Ptolemaic Era

One outlier from the reign of Ptolemy II seems to fuse two methods of approximating the change in daylight. The scribe began with a scale of 12 fingerbreadths for the month containing the equinoxes. In the month before the equinoxes, the length of daylight changed by half a fingerbreadth, but in the month after the equinoxes, the length of daylight varied by a full fingerbreadth. Two months before the equinox, the scribe approximated the change in daylight by half a fingerbreadth, but two months after he used 2/3 of a fingerbreadth. Only the month containing the summer solstice survives. In this month, the scribe allowed a change of only 1/3 of a fingerbreadth. As usual, the epagomenal days are neglected, but more troubling than this omission are the facts that this scheme does not preserve symmetry and that it yields an irregular approximation.

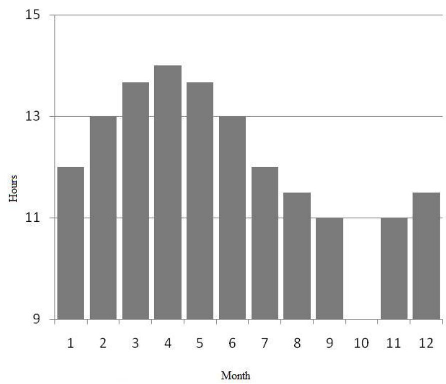

Fig. 9 - An Atypical Scheme of Seasonal Daylight from the Reign of Ptolemy II

Limitations of Water Clocks

As is often noted, no regularly divided scale will produce correct hours when used for outflow water clocks because the design of the vessels did not permit a constant water flow. When the clock began to run, the weight of the water caused the initial flow to be stronger than the final drops which dribbled out. Most importantly, the change in the rate of flow is not linear, but depends on the square root of the height of the liquid – a factor which decreases over time. The change in the rate of flow could be arbitrarily minimized by adding a reservoir of sufficient size, effectively decreasing the total change of the water level over twelve hours. Indeed, in none of the preserved water clocks was the water allowed to run out completely. Whatever the accuracy of Egyptian time-keeping may have been, the structure of the outflow water clocks does permit insight into how the Egyptian scribes conceptualized the change in the length of daylight during the year.[51]

In-Flow Water Clock of Edfu

By the end of the first century A.D., the technical limitations of the outflow water clock had been addressed at least once. At Edfu, an inflow water clock was used to mark the passage of the nocturnal hours. Whereas outflow water clocks dripped dry during the night, the inflow water clock at Edfu was slowly filled. The hour indicated by the intersection of the water level and a roughly drawn grid of horizontal lines for the hours and vertical lines indicating the months. From measurements, Borchardt determined that this water clock returned to the system cited by Amenemhat: the longest night is 14 fingerbreadths; the shortest is 12 fingerbreadths. The months containing the equinoxes span 13 fingerbreadths. The distances between the vertical lines indicating the months are not constant. Alexander Pogo explained these differences by postulating the existence of a rationally constructed prismatic inflow water clock.[52] Using the scales known from the solstices and equinoxes and mapping the grid onto an inflow water clock with a square base, Pogo determined another scheme to approximate the change in sunlight. In this scheme, the length of daylight in the months surrounding the solstices corresponds to a difference of 1/6 of a fingerbreadth. The length of daylight in the months before and after the equinoxes corresponds to a difference of half a fingerbreadth. The construction, as presented by Pogo, is simple to comprehend, and offers a plausible speculation. Indeed, Pogo's explanation is adopted by Clagett even though Pogo weakens his case through fanciful interpretations of the forms of several hieroglyphs.

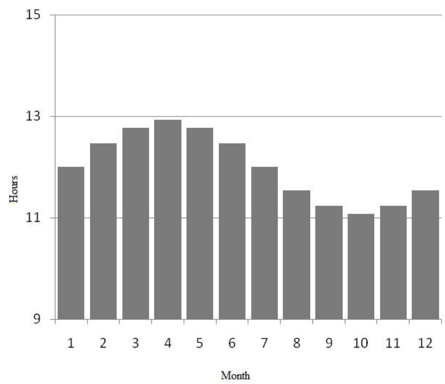

Fig. 10 - Scheme of Seasonal Daylight for the In-Flow Water Clock of Edfu

[51] For a more thorough investigation of the question, see J. Høyrup, (1997-98). The question has been somewhat confused by a cuneiform text which implies that equal weights of water result in equal hours.

[52] For this geometric construction, see Pogo, (1936). For a reproduction of the relevant passages, see Clagett, (1995).

Seasonal Hours in Greek Sources

The Greek methods for calculating the length of daylight differ somewhat from the Egyptian methods. Babylonians, Egyptians, and Greeks understood that the length of daylight changed throughout the year and sought to create models of these natural phenomena. However, the surviving Babylonian and Egyptian models remained local approximations, while the best Greek models embraced a global perspective and attempted to account for variation in daylight according to the position of the observer as well as the time of the year. In fact, several Greek authors used the length of the longest day to divide the Earth into several zones, or κλιματα.

Not only did the Greek astronomers recognize that length of daylight depended on the latitude of the observer, but they also chose a more absolute method of indicating the time of year. Most Greeks abandoned the reckoning of daylight by months and replaced the months with the position of the Sun among the zodiacal signs. The first to opt for this astronomical method of indicating the time of year was Hypsicles, although his methods were flawed.

At least two Greek authors continued the tradition of finding seasonal hours for each month. Cleomedes argues that in the months before and after the solstices, daylight changes by 1/12 of the difference between the longest and shortest day. Two months from the solstices, daylight changes by 1/6 of the difference. In the months before and after the equinoxes, daylight changes by 1/4 of the amount. However, Cleomedes gives this progression as a general rule and indicates the maximal length of daylight only for the Hellespont, Britain and Thule.[53]

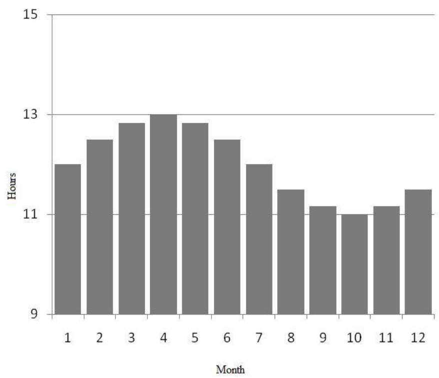

Fig. 11 - Scheme of Seasonal Daylight According to Cleomedes

A Greek source more closely related to the Egyptian practices was discovered in Antinoë by Evaristo Breccia in 1937.[54] This Greek text was written on a Coptic palimpsest which has been assigned to the 7th or 8th C. A.D. on the basis of paleography. This scheme sets the longest days and nights at 16 hours, and the shortest at eight hours. Each month, the scribe increases or decreases the length of daylight by 1 1/3 hours. Thus, the

53 *Caelestia* 1.4.18–29.

54 For the publication of this papyrus (=PSI 13[1], 1296), see Mercati (1953), 1–11.

scheme couples the Babylonian ratio of longest to shortest days, 2:1, with the regular monthly variations used in the Karnak water clock of Amenhotep III and P. Cairo 86637. That such a poor scheme of approximation was be used at such a late date provokes speculation that the schema was more closely linked to the structure of water clocks than the conceptualization of the change in the length of daylight.

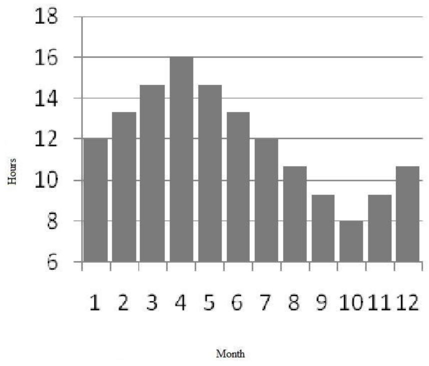

Fig. 12 - Scheme of Seasonal Daylight According to PSI 13, 1296

Other Greek writers including Ptolemy and Geminos discuss the change of daylight in different terms. Rather than give the month-by-month measurements, they relate the seasonal change in the length of daylight to the position of the Sun in the zodiac.

Seasonal Hours in OMM 170, 796 and 844

The fractions which conclude each month for the series contained on OMM 170, 796 and 844 relate to the seasonal change in the length of daylight. OMM 170 contains three fractions for the months 1 through 3 which ought to correspond with the dates 6 months later. Although months 4 through 6 are missing, the months 7 through 10 are found on OMM 796. On this ostracon, the fractions do not agree with OMM 170. On OMM 170, the fraction 1/16 is flanked by two instances of 1/13. In OMM 796, 1/16 is next to 1/14. Because symmetry is not preserved for the increase and decrease in the length of daylight, some error appears to have entered the scheme. If 1/14 is inserted before the entry of 1/16 in month 2, the second instance of 1/16 will fall in the expected month. Likewise, another 1/14 after month 3 restores symmetry. With the insertion of two instances of 1/14, the rest of the factions can be restored by symmetry.

Month	Change	Month	Change
Thoth	1/13	Phamenoth	1/10+x
Phaophi	1/16	Pharmouthi	1/14
Hathor	1/13	Pachons	1/16
Choiak	…	Pauni	1/14
Tybi	…	Epeiph	1/13
Mecheir	…	Mesore	1/12

Month	Change	Month	Change
Thoth	1/13	Phamenoth	1/13
Phaophi	***1/14(!)***	Pharmouthi	1/14
Hathor	***1/16***	Pachons	1/16
Choiak	***1/14(!)***	Pauni	1/14
Tybi	1/13	Epeiph	1/13
Mecheir	1/12	Mesore	1/12

Fig. 13 - Scheme of Seasonal Daylight as Preserved (Left) and Restored by Symmetry (Right)

Without the missing ostracon, how the scribe handled the two missing entries cannot be known. Perhaps the error was the fault of the scribe who later remembered that 1/14 preceded 1/16. Perhaps the scribe slavishly copied a corrupt source, or possibly he tried to rationalize conflicting sources which placed the equinoxes and solstices in conflicting months.

The first question which must be answered in an analysis of the scheme contained in the OMM series is whether the Alexandrian or Egyptian calendar was used. The section treating the epagomenal days omits the sixth intercalary day of the Alexandrian calendar, but because the day occurred only every fourth year and because the hemerology does not contain every day of the year, this omission does not confirm the use of the Alexandrian calendar or deny the use of the Egyptian calendar. The question can be answered by attempting to fix the dates of the solstices.

According to the Alexandrian calendar, the solstices and equinoxes remained in the same month each year. In particular, the equinoxes fell in the first and seventh months of the year. In the series from Medînet Mâdi, these months both record the fraction 1/13, which is neither the minimum nor maximum fraction and thus difficult to rationalize with the length of daylight at either the solstices or the equinoxes. The solstices fell in the fourth and tenth months. Only the fraction associated with the tenth month of the series survives. Again, 1/14 is neither a minimum nor a maximum. According to the Egyptian calendar, the equinoxes occurred one day earlier every four years, completing a cycle every 1,460 years. Between about A.D. 112 and 232, the summer solstice fell in the twelfth month of the year according to the Egyptian calendar. These dates agree with the fact that the twelfth month is associated with 1/12, the largest fraction, and also with the era in which Medînet Mâdi was known from other sources to be active.[55] If the listing of the epagomenal days can be trusted, the dates for which the calendar was intended can be narrowed to sometime in the latter third of this span, probably between A.D. 180 and 200, again in keeping with other dates from Medînet Mâdi.

The next question which must be answered is what connection the fractions have with the months. Because of the roughly symmetrical distribution of the fractions throughout the year (somewhat arbitrarily improved by the restored version), the fractions ought to relate to the seasonal change in the length of daylight. The length of daylight changes in two ways. First, the amount of daylight increases or decreases as time passes from equinox to solstice. Secondly, the rate at which the amount of daylight changes slows in the time from equinox to solstice. Because the largest fractions are associated with the months containing the solstices, these fractions must relate to the total amount of daylight.

Exactly how these fractions relate to the amount of daylight depends on whether the length of daylight at the solstices or equinoxes is taken as normative. If the length of daylight during the solstice is taken as normative, the seasonal hours for the other months

[55] For a general summary of the dates of the Medînet Mâdi archive by the names of officials, see Pintaudi and Sijpesteijn, (1993, 11-12). Add to this the work of Gallo (1997, li-liii). For astronomical data extending the period of activity to the reign of Septimius Severus, see Ross (forthcoming).

may be computed in turn. According to Ptolemy, the third clime contained the Fayum and enjoyed 14:00 hours, or 840 equinoctial minutes, of daylight on the summer solstice. If one seasonal hour for the month containing the solstice is taken to be 1/12 of 840, the longest hours are 70 minutes long – a good approximation of the astronomical phenomena. If one seasonal hour for the month containing the equinoxes is computed as 1/16 of 840, the equinoctial hours are 52 1/2 minutes long, a troubling result because it corresponds better with the winter solstice than the equinoxes. Finally, if the days of the summer solstice are 70 minutes long, the days of the winter solstice ought to be 50 minutes long, another good approximation.

On the other hand, if the equinoctial hours are taken as normative, one seasonal hour ought to be 1/16 of 960 equinoctial minutes. For the solstices, the longest hours ought to be 1/12 of 960 equinoctial minutes, or 80 minutes. Thus, the shortest hours ought to be only 40 minutes, making the ratio of the longest to shortest day 2:1, a poor approximation from an astronomical perspective but an approximation in evidence from other sources and better than the ratio of 3:1 proposed in the scheme in P. Cairo 86637. The assumption that the seasonal hours were normative results in a poor approximation, but a poor approximation that is both internally consistent and known to have been used in other sources. Because the division of seasonal hours was linked with the practices of time-keeping, a full explication of the fractions cannot be separated from a discussion of these techniques. Possibly what appears to be a poor approximation may have been intended to correct the error inherent in an out-flow water clock.[56] For the present purposes, it is sufficient to establish only that the text is in conformity with the textual tradition of seasonal hours.

Indeed, the work of Amenemhat seems to be more academic than useful. Although modern scholars may question the accuracy of the change in the length of daylight by regular intervals, most Egyptian scribes probably never noticed any disparity. The best ancient approximation of the difference between the longest and shortest days for the northernmost portion of Egypt amounts to only 2 hours, which corresponds to a 10 minute (or 16.7%) increase in each hour. For the Fayum, where Medinet Madi is located, the difference between the longest day and shortest day is as small as 1 hour and 45 minutes.

Discussion

We can conclude that OMM 170, 796 and 844 currently have no direct parallel among other Demotic, Greek or Coptic sources, but can be settled into the divinatory landscape of Greco-Roman Egypt. The text combines the indigenous tradition of calculating seasonal hours with the foreign, but long-standing, practice of hemerology. These texts bear provisional character and may have served as an aide-mémoire for the diviner. Consequently, they should not be thought of a manual to an oracle book like the other examples which

[56] A full discussion of the mechanics of water clocks is outside the scope of the present article but will form the basis of a future investigation.

were used in presence of the petitioner. Thus, a high-quality papyrus version must have existed.[57] Alternately, the provisional character might result from the fact that the ostraca represent a personal copy made from a papyrus hemerology. These ostraca could have allowed the copyist to know correctly which days the oracle connected with the OMM 170, 844 and 796 was available for consultation. The possibility of a solely private use, however, should be ruled out by the circumstance that the ostraca were found inside the *temenos* of the temple of Medînet Mâdi in a room that could be described as an archive of priests. Maybe the archive survived in the location where texts representing the process of other divinatory techniques such as *ticket oracles*, the storage of divinatory papyri, or the consultation of oracle books took place, a location with limited access to the public and many priests. Unfortunately, we can only speculate about the practice of divination in antiquity, for the archaeological remains are not as specific as we would like them to be.

Outside of textual evidence, the little we do know about divinatory practice in antiquity tends to negate a private use of OMM 170, 796 and 844. The ostraca of Medînet Mâdi seem to belong to a multipart structure of perhaps several mantic methods. These ostraca correspond to one step in a division of labor which demands both an initiation into the system and a literate public.[58] The actors in divination at Medînet Mâdi are not known, but in the case of the *Sortes Astrampsychi*, the multipart structure was composed of a professional diviner who played a brief role and the petitioners who questioned him. Perhaps the diviner was even entitled to some payment. In the case of an educated elite, the content of their questions must have been restricted to this privileged audience whose discretion could be assured. This divinatory structure could not have compromised the social classes from slaves to minor local governors such as the dekaprotoi. Indeed, this communicative situation shifted in later centuries, when such books of sortition became a source of private amusement. These so-called “do-it-yourself-oracles” have been treated by W. Clarysse and others.[59] The ostraca OMM 170, 796 and 844, however, are unsuited for consultation by individuals.

What must not be forgotten in this discussion about the professional staff in Egypt is the existence of “freelancers” – mobile or local diviners, independent of priestly institutions and the temple. Though evidence is much scantier in Egypt than in Greece or Asia Minor, we cannot exclude the possible existence of such individuals.[60] For example, large

[57] Consider that the codex P. Oxy. 67, 4581 which contained the *Sortes Astrampsychi* was written in a nearly uncial script, with ornaments and wide margins.

[58] For this difficult topic, see Beard, (1991, 35-58) and the contribution of Hanson, (1991, 159-98). The standard source for Egypt, though highly speculative in method, remains Baines and Eyre, (1983).

[59] See Clarysse, (1996, 65-70). For the epigraphic evidence from the dice or astragalus-oracles from Asia Minor, see now Nollé, (2007).

[60] A prominent figure in Egyptian social life is the “wise woman” (*tꜣ rḫ.t*), or the “wise man,” or “holy man,” (*rmt rḫ*). For the wise woman, known from New Kingdom texts from Deir el-Medina, see Karl, (2000). For the wise man, see the end of col. 2 of P. Queen’s College, a narrative with mantic context to be published by H.-W. Fischer-Elfert. For the “Holy Man” as a frequent *terminus technicus* in Coptic-Byzantine times, see Brown, (1971, 80-101). The commercial signboard of a Cretan dream interpreter in Saqqara (Cairo, CG 27567) is a famous example of one such practitioner from the second c. B.C.

parts of the magical papyri and many ritual texts have been found in a Theban tomb of a priest. The precise circumstances surrounding how they came to be there and why they were stored in this way may never be clear to us.

Many Babylonian, Egyptian and Greek texts contain hemerologies. In fact, enough hemerologies exist that they may be considered a genre of text. Hemerologies provide cultural information about the appropriate times for festivals, divinatory activities, and magic rituals. We can say with certainty that in antiquity, it was customary to limit divinatory practices to special days. Even the famous oracle of Delphi had fixed days of consultation.[61] From OMM 170, 796 and 844 we can also see that the desire to coordinate significant events extended to the hours of the day. The computation of the change in the length of seasonal hours began in Egypt during the Middle Kingdom. From this beginning, the division of seasonal hours (and the twenty-four hour day) spread to Babylon and Greece, both of which made adaptations and refinements. The text on OMM 170, 796 and 844 establishes that the division of seasonal hours at Medînet Mâdi form a continuity with other such Egyptian calculations. Because these calculations depend on water clocks and perhaps other time-keeping technologies, the understanding of these calculations cannot be separated from the cultural practices of time-keeping. Although these approximations may seem crude and inaccurate, the horoscopes from Medînet Mâdi are accurate to the hour and imply the existence of a good approximation. Even today, in esoteric circles, the coordination of significant events in life such as weddings or surgeries with the lunar phases is common. Although such katarchic astrology may not have been fully developed at Medînet Mâdi, the elements of its development were already well established.

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[61] At first, divination was performed only one day year, then later each Pythia (the Apollo priestess) performed divinations for nine days. In times of many requests, a maximum of three Pythiae functioned as the inspired mediums of Apollo. For a synthesis of the sources (such as Paus. 3.4.4), see Maaß (1993).

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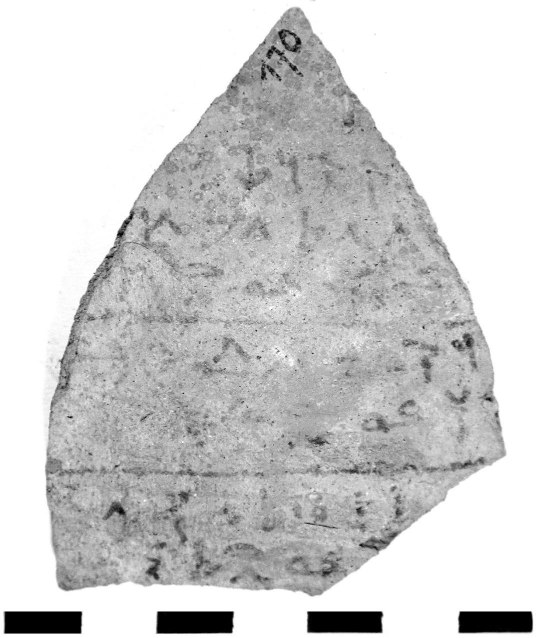
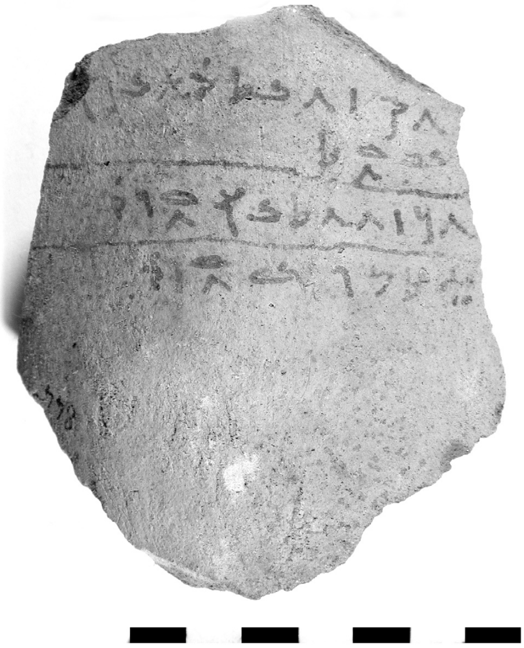


OMM 170

OMM 796



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